

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

IN RE THE APPLICATION OF: WASHIO, ET AL.

APPLICATION NO.: 10/561,802

FILLING DATE: DECEMBER 22, 2005

GROUP ART UNIT: 1795

EXAMINER: LE, HOA VAN

TITLE: DEVELOPER COMPOSITION FOR RESISTS AND METHOD FOR  
FORMATION OF RESIST PATTERN

**DECLARATION UNDER 37 C.F.R. § 1.132**

Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

Sir:

I, Yasushi WASHIO, do hereby declare that:

I have been an employee of Tokyo Ohka Kogyo Co., Ltd., Japan, the assignee of the above-identified United States patent application, since April 1, 1996, being engaged in research and development work relating to resist compositions.

I am one of the applicants of the above-identified application and I am well familiar with the present case;

I carried out the examples of the present application.

I have a good knowledge of the English language and have read and understood the application papers and the prosecution history of this and the antecedent applications as well as the Examiner's references cited therein.

I have made observations to evaluate the significant effects obtained by the use of the specific developer composition as claimed.

## PURPOSE, METHOD AND RESULTS

### (1) Purpose of the observation

The purpose of the Experiments described in this declaration is to evaluate the significant effects obtained by the use of the specific developer composition as claimed.

### (2) Observations

Each developer composition used in Examples 1 to 15 and Comparative Examples 1 and 2 were prepared by adding each anionic surfactant shown in Table 1 to an aqueous solution of 2.38% by mass of tetramethylammonium hydroxide (see page 10, lines 18-21 of the present specification).

In Examples 1 to 12 and Comparative Example 1 and 2, a positive-working photoresist containing a novolak resin and a naphthoquinone diazide compound was applied to a wafer to form a resist film, and the resist film, followed by prebaking and exposure of the resist film. Then, the resist film was subjected to development using the prepared developer composition to form a resist pattern.

The pattern size of the bottom portion of the resulting resist pattern was measured by cross section SEM (manufactured by Hitachi, Ltd., under the trade name "S4000").

The relative dissolution time as an item for evaluation in the table is a value obtained in the case in which the time required to remove a pattern having a fixed thickness and a fixed area (1 cm in length  $\times$  1 cm in width  $\times$  20  $\mu$ m in thickness) is 1.00 when the anionic surfactant is not added.

The dimensional controllability is evaluated according to the following criteria.  
A (Excellent): The formed resist pattern has a dimensional tolerance within  $\pm 5\%$  based on a target of a mask pattern.

B (Good): The formed resist pattern has a dimensional tolerance within  $\pm 10\%$  based on a target of a mask pattern.

C (Poor): The formed resist pattern has a dimensional tolerance over  $\pm 10\%$  based on a target of a mask pattern.

Further, in Examples 13 to 15, substantially the same procedure as in Examples

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1 to 12 and Comparative Example 1 and 2 was performed, except that various conditions were changed (see page 11, lines 20 to page 14, line 18).

For easier reference, Table 1 is reproduced below.

Table 1

	Anionic surfactant		Relative dissolution time	Dimensional controllability	Film thickness
	Kind	Amount (ppm)			
Example 1	$C_5H_{11}-\text{C}_6\text{H}_4-\text{O}-\text{C}_6\text{H}_4-\text{SO}_3\text{Na}$	1000	0.95	B	20
Example 2	$C_7H_{15}-\text{C}_6\text{H}_4-\text{O}-\text{C}_6\text{H}_4-\text{SO}_3\text{Na}$	2000	0.90	B	20
Example 3	$C_{12}H_{25}-\text{C}_6\text{H}_4-\text{O}-\text{C}_6\text{H}_4-\text{SO}_3\text{Na}$	2000	0.90	B	20
Example 4	$C_{12}H_{25}-\text{C}_6\text{H}_4-\text{O}-\text{C}_6\text{H}_3(\text{SO}_3\text{Na})_2$	3000	0.85	B	20
Example 5	$C_{15}H_{31}-\text{C}_6\text{H}_4-\text{O}-\text{C}_6\text{H}_4-\text{SO}_3\text{Na}$	10000	0.60	B	20
Example 6	$C_9H_{19}-\text{C}_6\text{H}_4-\text{O}-\text{C}_6\text{H}_4-\text{SO}_3\text{Na}$	8000	0.70	B	20
Example 7	$C_8H_{17}-\text{C}_6\text{H}_4-\text{O}-\text{C}_6\text{H}_4-\text{SO}_3\text{Na}$ $C_{15}H_{31}-\text{C}_6\text{H}_4-\text{O}-\text{C}_6\text{H}_4-\text{SO}_3\text{Na}$	2500+2500	0.80	B	20
Example 8	$C_{15}H_{31}-\text{C}_6\text{H}_4-\text{O}-\text{C}_6\text{H}_4-\text{SO}_3\text{Na}$	5000	0.75	B	20
Example 9	$C_{12}H_{25}-\text{C}_6\text{H}_4-\text{O}-\text{C}_6\text{H}_3(\text{SO}_3\text{K})_2$	3000	0.85	B	20
Example 10	$C_{12}H_{25}-\text{C}_6\text{H}_4-\text{O}-\text{C}_6\text{H}_3(\text{SO}_3\text{Ca}_{1/2})_2$	3000	0.90	B	20
Example 11	$C_{12}H_{25}-\text{C}_6\text{H}_4-\text{O}-\text{C}_6\text{H}_3(\text{SO}_3\text{Na})_2$	20000	0.50	A	20
Example 12	$C_{12}H_{25}-\text{C}_6\text{H}_4-\text{O}-\text{C}_6\text{H}_3(\text{SO}_3\text{Na})_2$	50000	0.40	B	20
Example 13	$C_{12}H_{25}-\text{C}_6\text{H}_4-\text{O}-\text{C}_6\text{H}_3(\text{SO}_3\text{Na})_2$	3000	0.85	B	5
Example 14	$C_{12}H_{25}-\text{C}_6\text{H}_4-\text{O}-\text{C}_6\text{H}_3(\text{SO}_3\text{Na})_2$	3000	0.85	B	50
Example 15	$C_{12}H_{25}-\text{C}_6\text{H}_4-\text{O}-\text{C}_6\text{H}_3(\text{SO}_3\text{Na})_2$	3000	0.85	B	80
Comparative Example 1	$C_{12}H_{25}-\text{C}_6\text{H}_4-\text{O}-\text{C}_6\text{H}_3(\text{SO}_3\text{NH}_4)_2$	10000	1.20	B	20
Comparative Example 2	—	—	1.00	C	20

(3) Results

As seen from Table 1, the relative dissolution time of the claimed alkali metal-containing surfactants in Examples 4, 9 and 10 of the present specification is significantly lower than the corresponding ammonium-based surfactant in Comparative Example 1, while maintaining satisfactory dimensional controllability. Here, the relative dissolution time of 0.5 in Example 11 was 3 minutes in terms of actual dissolution time. Needless to say, in other examples, the actual dissolution time varies in proportion with the relative dissolution time.

Further, Examples 1 to 15 show that similar results can be obtained by using various types of anionic metal-containing surfactants in various amounts (1,000-50,000 ppm).

(4) Conclusion

From the results shown above, it can be fairly concluded that the dissolution rate (developing sensitivity) is unexpectedly significantly improved when a metal containing anionic surfactant is used, compared to the dissolution rate obtained when an ammonium anionic surfactant is used, while maintaining satisfactory dimensional controllability. Further, it can be fairly concluded that such excellent effect can be achieved over the claimed range.

I further declare that all statements made herein to our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Yasushi Washio  
Signature (Yasushi WASHIO)

June 2, 2010  
Date